

**STOCK ASSESSMENT AND FISHERY EVALUATION REPORT**  
**FOR THE GROUND FISH RESOURCES**  
**OF THE GULF OF ALASKA**

**Compiled by**

The Plan Team for the Groundfish Fisheries of the Gulf of Alaska



with contributions by

G. Adams, C. Allen-Akselrud, K. Aydin, S. Barbeaux, L. Barnett, M. Bryan, M. Callahan, M. Cheng, S. Cleaver, J. Conner, G. Correa, O. Davis, M. Dorn, A. Dreary, G. Dunne, K. Echave, R. Ehresmann, C. Faunce, B. Ferriss, B. Fissel, K. Fuller, D. Goethel, M. Hall, R. Haehn, L. Hillier, D. Hanselman, J. Hoff, K. Holsman, T. Honkalehto, P. Hulson, J. Ianelli, M. Jaenicke, D. Jones, P. Joy, M. Kapur, K. Kearney, A. Kingham, N. Laman, M. Levine, S. Lowe, C. Lunsford, P. Malecha, E. Markowitz, M. Matta, S. McDermott, C. McGilliard, D. McGowan, D. McKelvey, C. Monnahan, N. Nichols, C. O'Leary, A. Olson, K. Omori, O. Ormseth, O. Ortiz, Z. Oyafuso, A. Punt, C. Rodgveller, L. Rogers, J. Rumble, E. Siddon, K. Shotwell, K. Siwicki, P. Spencer, I. Spies, S. Stienessen, J. Sullivan, C. Szuwalski, M. Szymkowiak, T. TenBrink, G. Thompson, C. Tribuzio, A. Tyrell, B. Williams, K. Williams, M. Williams, E. Yasumiishi, C. Yeung, S. Zador

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**North Pacific Fishery Management Council**  
**1007 West Third, Suite 400**  
**Anchorage, AK 99501**

# Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska

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## Summary

The *National Standard Guidelines for Fishery Management Plans* published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). The SAFE reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries under federal management. The FMPs for the groundfish fisheries managed by the North Pacific Fishery Management Council (Council) require that drafts of the SAFE reports be produced each year in time for the December Council meetings.

The SAFE report for the Gulf of Alaska (GOA) groundfish fisheries is compiled by the Plan Team for the Gulf of Alaska Groundfish FMP from chapters contributed by scientists at NMFS Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G). The stock assessment section includes recommended acceptable biological catch (ABC) levels for each stock and stock complex managed under the FMP. The ABC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other management strategies for the fisheries.

The GOA Groundfish Plan Team met at the Alaska Fishery Science Center in Seattle on November 14-18, 2022 to review the status of stocks of eighteen species or species groups that are managed under the FMP. The Plan Team review was based on presentations by ADF&G and NMFS AFSC scientists with opportunity for public comment and input. Members of the Plan Team who compiled the SAFE report were James Ianelli (co-chair), Chris Lunsford (co-chair), Craig Faunce, Sandra Lowe, Kresimir Williams, Pete Hulson, Janet Rumble, Nat Nichols, Marysia Szymkowiak, Paul Spencer, Andrew Olson, Sara Cleaver, Obren Davis, Kristan Blackhart, Lisa Hillier, Cecilia O’Leary, and Ben Williams.

### *Management Areas and Species*

The Gulf of Alaska (GOA) management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Fig. 1). Formerly, five categories of finfishes and invertebrates were designated for management purposes: target species, other species, prohibited species, forage fish species and non-specified species. Effective for the 2011 fisheries, these categories have been revised in Amendments 96 and 87 to the FMPs for Groundfish of the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA), respectively. This action was necessary to comply with requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to prevent overfishing, achieve optimum yield, and to comply with statutory requirements for annual catch limits (ACLs) and accountability measures (AMs). Species and species groups must be identified “in the fishery” for which ACLs and AMs are required. An ecosystem component (EC) category is also included in the FMPs for species and species groups that are not:

- 1) targeted for harvest
- 2) likely to become overfished or subjected to overfishing, and
- 3) generally retained for sale or personal use.

The effects of the 2011 action amended the GOA and BSAI groundfish FMPs to

- 1) identify and manage target groundfish stocks “in the fishery”
- 2) eliminate the “other species” category and manage (GOA) squids, (BSAI and GOA) sculpins, (BSAI and GOA) sharks, and (BSAI and GOA) octopuses separately “in the fishery”;
- 3) manage prohibited species and forage fish species in the ecosystem component category; and
- 4) remove the non-specified species outside of the FMPs.

Amendments 91/100 added grenadiers to the GOA and BSAI FMPs as an Ecosystem Component in 2014. Amendments 106/117 moved squid to the Ecosystem Component category of the FMP in GOA and BSAI

FMPs in 2018. Amendments 110/121 moved sculpins to the Ecosystem Component category of the FMPs in 2020.

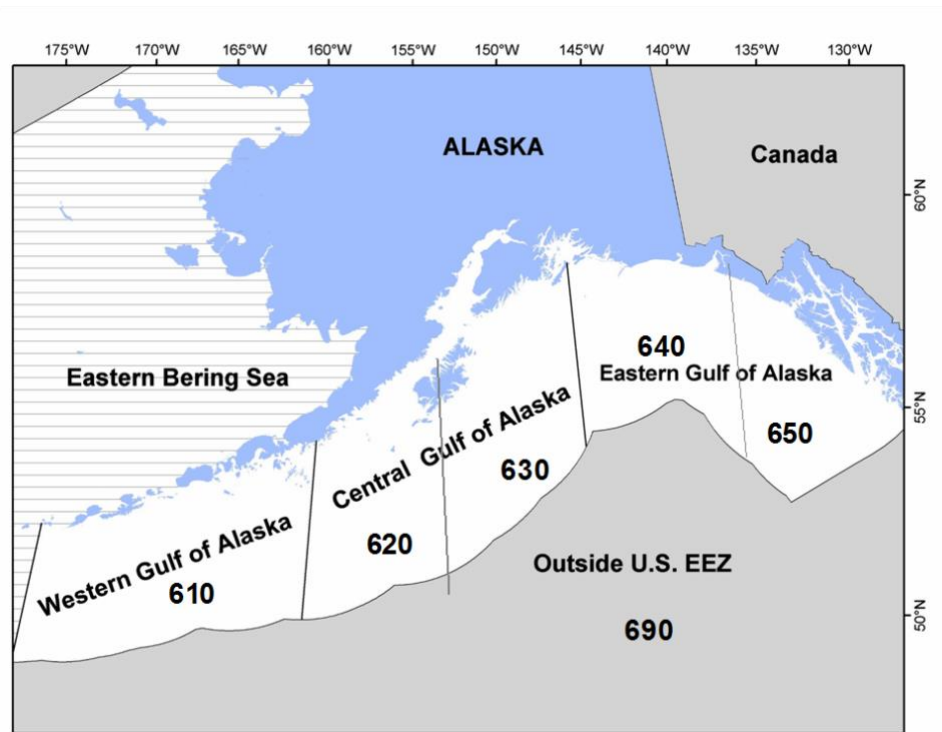


Figure 1. Gulf of Alaska statistical and reporting areas.

Species may be split or combined within the “target species” category according to procedures set forth in the FMP. The three categories of finfishes and invertebrates that have been designated for management purposes are listed below.

In the Fishery:

Target species – are those species that support a single species or mixed species target fishery, are commercially important, and for which a sufficient database exists that allows each to be managed on its own biological merits. Accordingly, a specific total allowable catch (TAC) is established annually for each target species or species assemblage. Catch of each species must be recorded and reported. This category includes walleye pollock, Pacific cod, sablefish, deep water flatfish, shallow water flatfish, rex sole, flathead sole, arrowtooth flounder, Pacific ocean perch, shorttraker rockfish, rougheye/blackspotted rockfish, northern rockfish, “other” rockfish, dusky rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, sharks, octopus, big skates, longnose skates, and other skates.

Ecosystem Component:

- 1) Prohibited Species—are those species and species groups the catch of which must be avoided while fishing for groundfish, and which must be immediately returned to sea with a minimum of injury except when their retention is authorized by other applicable law. Groundfish species and species groups under the FMP for which the quotas have been achieved shall be treated in the same manner as prohibited species.
- 2) Forage fish species—are those species listed in the table below, which are a critical food source for many marine mammal, seabird and fish species. The forage fish species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for forage fish. Management measures for this species category will be specified in regulations. These may include measures prohibiting

directed fishing, limiting allowable bycatch retention, or limiting commercial exchange and the processing of forage fish in a commercial facility.

- 3) Grenadiers – The grenadier complex (family Macrouridae), also known as “rattails”, are comprised of at least seven species of grenadier known to occur in Alaskan waters, but only three are commonly found at depths shallow enough to be encountered in commercial fishing operations or in fish surveys: giant grenadier (*Albatrossia pectoralis*), Pacific grenadier (*Coryphaenoides acrolepis*), and popeye grenadier (*Coryphaenoides cinereus*).
- 4) Squids –There are approximately 15 species of squids in the GOA, which are mainly distributed along the shelf break. The most abundant species is *Berryteuthis magister* (magistrate armhook squid). Squid in Alaska are generally taken incidentally in the target fishery for pollock. Catches of squids are generally low relative to population size and most of the squid bycatch occurs in the central GOA.
- 5) Sculpins

The following lists the GOA stocks within these FMP species categories:

<b>In the Fishery</b>	
Target Species <sup>1</sup>	Walleye pollock, Pacific cod, Sablefish, Flatfish (shallow-water flatfish, deep-water flatfish, rex sole, flathead sole, arrowtooth flounder), Rockfish (Pacific ocean perch, northern rockfish, shortraker rockfish, rougheye/blackspotted rockfish, other rockfish, dusky rockfish, demersal shelf rockfish <sup>3</sup> , thornyhead rockfish), Atka mackerel, skates (big skates, longnose skates, and other skates), sharks, octopus
<b>Ecosystem Component</b>	
Prohibited Species <sup>2</sup>	Pacific halibut, Pacific herring, Pacific salmon, Steelhead trout, King crab, Tanner crab
Forage Fish Species <sup>4</sup>	Osmeridae family (eulachon, capelin, and other smelts), Myctophidae family (lanternfishes), Bathylagidae family (deep-sea smelts), Ammodytidae family (Pacific sand lance), Trichodontidae family (Pacific sand fish), Pholidae family (gunnels), Stichaeidae family (pricklebacks, warbonnets, eelblennys, cockscombs, and shannys), Gonostomatidae family (bristlemouths, lightfishes, and anglmouths), Order Euphausiacea (krill)
Grenadiers <sup>5</sup>	Macrouridae family (grenadiers)
Squids <sup>6</sup>	Chiroteuthidae family, Cranchiidae family, Gonatidae family, Onychoteuthidae family, Sepiolidae family,
Sculpins <sup>7</sup>	Families: Cottidae, Hemitripterae, Psychrolutidae, and Rhamphocottidae

<sup>1</sup> TAC for each listing. Species and species groups may or may not be targets of directed fisheries

<sup>2</sup> Must be immediately returned to the sea

<sup>3</sup> Management delegated to the State of Alaska

<sup>4</sup> Management measures for forage fish which are an Ecosystem Component are established in regulations implementing the FMP

<sup>5</sup> The grenadier complex was added to both FMPs as an Ecosystem Component in 2014

<sup>6</sup> The squid complex was added to both FMPs as an Ecosystem Component in 2018 and implemented in 2019

<sup>7</sup> Sculpins were added to both FMPS as an Ecosystem Component in 2019 and implemented in 2020.

This SAFE report describes stock status of target and non-target species in the fishery.

A species or species group from within the fishery category may be split out and assigned an appropriate harvest level. Similarly, species in the fishery category may be combined and a single harvest level assigned to the new aggregate species group. The harvest level for demersal shelf rockfish in the Eastern

Regulatory Area is specified by the Council each year. However, management of this fishery is deferred to the State of Alaska with Council oversight.

The GOA FMP recognizes single species and species complex management strategies. Single species specifications are set for stocks individually, recognizing that different harvesting sectors catch an array of species. In the Gulf of Alaska these species include pollock, Pacific cod, sablefish, Pacific ocean perch, flathead sole, rex sole, arrowtooth flounder, northern rockfish, shortraker rockfish, dusky rockfish, Atka mackerel, big skates, and longnose skates. Other groundfish species that are usually caught in groups have been managed as complexes (also called assemblages). For example, other rockfish, rougheye and blackspotted rockfish, demersal shelf rockfish, thornyhead rockfish, deep water flatfish, shallow water flatfish, skates, sharks, and octopus have been managed as complexes.

The FMP authorizes splitting species, or groups of species, from the complexes for purposes of promoting the goals and objectives of the FMP. Atka mackerel was split out from “other species” beginning in 1994. In 1998, black and blue rockfish were removed from the GOA FMP and management was conferred to the ADF&G. In 2008, dark rockfish were similarly removed from the GOA FMP with sole management taken over by the ADF&G. Beginning in 1999, osmerids (eulachon, capelin and other smelts) were removed from the “other species” category and placed in a separate forage fish category. In 2004, Amendment 63 to the FMP was approved which moved skates from the other species category into a target species category whereby individual OFLs and ABCs for skate species and complexes could be established.

Groundfish catches are managed against TAC specifications for the EEZ and near coastal waters of the GOA. State of Alaska internal water groundfish populations are typically not covered by NMFS surveys and catches from internal water fisheries are generally not counted against the TAC. The Team has recommended that these catches represent fish outside of the assessed region and should not be counted against an ABC or TAC. Beginning in 2000, the pollock assessment incorporated the ADF&G survey pollock biomass, therefore, the Plan Team acknowledged that it is appropriate to reduce the Western (W), Central (C) and West Yakutat (WY) combined GOA pollock ABC by the anticipated Prince William Sound (PWS) harvest level for the State fishery. Since 2001, the W/C/WY pollock ABCs have been reduced by the PWS GHL as provided by ADF&G, before area apportionments were made. At the 2012 September Plan Team meeting, ADF&G presented a proposal to set the PWS GHL in future years as a fixed percentage of the W/C/WY pollock ABC of 2.5%. That value is the midpoint between the 2001-2010 average GHL percentage of the GOA ABC (2.44%) and the 1996 and 2012 levels (2.55%). The Plan Team accepted this proposal but noted concern regarding the lack of a biomass-based allocation in PWS. The Plan Team deducted a value for the 2023 and 2024 PWS GHL (equal to 2.5% of the recommended 2023 and 2024 W/C/WY pollock ABCs) from the recommended 2023 and 2024 W/C/WY pollock ABCs (listed in the summary table), before area apportionments are made. It is important to note that the value of the PWS GHL is dependent on the final specified W/C/WY pollock ABC. The values used by the Plan Team to derive the 2023 and 2024 W/C/WY pollock apportioned ABCs are listed in the pollock summary under *Area apportionment*.

The Plan Team has provided subarea ABC recommendations on a case-by-case basis since 1998. The Plan Team recommended splitting the EGOA ABC for species/complexes that would be disproportionately harvested from the West Yakutat area by trawl gear. The Team did not split EGOA ABCs for species that were prosecuted by multi-gear fisheries or harvested as bycatch. The approaches for splitting the EGOA ABCs are given in the specific stock assessments.

### *Biological Reference Points*

A number of biological reference points are used in this SAFE. Among these are the fishing mortality rate ( $F$ ) and stock biomass level ( $B$ ) associated with MSY ( $F_{MSY}$  and  $B_{MSY}$ , respectively). Fishing mortality rates reduce the level of spawning biomass per recruit to some percentage  $P$  of the pristine level ( $F_{P\%}$ ).

The fishing mortality rate used to compute ABC is designated  $F_{ABC}$ , and the fishing mortality rate used to compute the overfishing level (OFL) is designated  $F_{OFL}$ .

*Definition of Acceptable Biological Catch and the Overfishing Level*

Amendment 56 to the GOA Groundfish FMP, approved by the Council in June 1998, defines ABC and OFL for the GOA groundfish fisheries. The new definitions are shown below, where the fishing mortality rate is denoted  $F$ , stock biomass (or spawning stock biomass, as appropriate) is denoted  $B$ , and the  $F$  and  $B$  levels corresponding to MSY are denoted  $F_{MSY}$  and  $B_{MSY}$  respectively.

Acceptable Biological Catch is a preliminary description of the acceptable harvest for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under “overfishing” below.

Overfishing is defined as any amount of fishing more than a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is reliable for this definition and may use either objective or subjective criteria in making such determinations. For Tier (1), a pdf refers to a probability density function. For Tiers (1-2), if a reliable pdf of  $B_{MSY}$  is available, the preferred point estimate of  $B_{MSY}$  is the geometric mean of its pdf. For Tiers (1-5), if a reliable pdf of  $B$  is available, the preferred point estimate is the geometric mean of its pdf. For Tiers (1-3), the coefficient  $\alpha$  is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For Tiers (2-4), a designation of the form “ $F_{X\%}$ ” refers to the  $F$  associated with an equilibrium level of spawning per recruit (SPR) equal to X% of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For Tier (3), the term  $B_{40\%}$  refers to the long-term average biomass that would be expected under average recruitment and  $F=F_{40\%}$ .

<b>Tier</b>	<p>1) Information available: <i>Reliable point estimates of B and B<sub>MSY</sub> and reliable pdf of F<sub>MSY</sub>.</i></p> <p>1a) Stock status: <math>B/B_{MSY} &gt; 1</math>  <math>F_{OFL} = \mu_A</math>, the arithmetic mean of the pdf  <math>F_{ABC} \leq \mu_H</math>, the harmonic mean of the pdf</p> <p>1b) Stock status: <math>\alpha &lt; B/B_{MSY} \leq 1</math>  <math>F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)</math>  <math>F_{ABC} \leq \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)</math></p> <p>1c) Stock status: <math>B/B_{MSY} \leq \alpha</math>  <math>F_{OFL} = 0</math>  <math>F_{ABC} = 0</math></p> <p>2) Information available: <i>Reliable point estimates of B, B<sub>MSY</sub>, F<sub>MSY</sub>, F<sub>35%</sub>, and F<sub>40%</sub>.</i></p> <p>2a) Stock status: <math>B/B_{MSY} &gt; 1</math>  <math>F_{OFL} = F_{MSY}</math>  <math>F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})</math></p> <p>2b) Stock status: <math>\alpha &lt; B/B_{MSY} \leq 1</math>  <math>F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)</math>  <math>F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)</math></p> <p>2c) Stock status: <math>B/B_{MSY} \leq \alpha</math>  <math>F_{OFL} = 0</math>  <math>F_{ABC} = 0</math></p> <p>3) Information available: <i>Reliable point estimates of B, B<sub>40%</sub>, F<sub>35%</sub>, and F<sub>40%</sub>.</i></p> <p>3a) Stock status: <math>B/B_{40\%} &gt; 1</math>  <math>F_{OFL} = F_{35\%}</math>  <math>F_{ABC} \leq F_{40\%}</math></p> <p>3b) Stock status: <math>\alpha &lt; B/B_{40\%} \leq 1</math>  <math>F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)</math>  <math>F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)</math></p> <p>3c) Stock status: <math>B/B_{40\%} \leq \alpha</math>  <math>F_{OFL} = 0</math>  <math>F_{ABC} = 0</math></p> <p>4) Information available: <i>Reliable point estimates of B, F<sub>35%</sub>, and F<sub>40%</sub>.</i>  <math>F_{OFL} = F_{35\%}</math>  <math>F_{ABC} \leq F_{40\%}</math></p> <p>5) Information available: <i>Reliable point estimates of B and natural mortality rate M.</i>  <math>F_{OFL} = M</math>  <math>F_{ABC} \leq 0.75 \times M</math></p> <p>6) Information available: <i>Reliable catch history from 1978 through 1995.</i>  <math>OFL =</math> the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information  <math>ABC \leq 0.75 \times OFL</math></p>
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Overfished or approaching an overfished condition is determined for all age-structured stock assessments by comparison of the stock level in relation to its MSY level according to the following two harvest scenarios (Note for Tier 3 stocks, the MSY level is defined as  $B_{35\%}$ ):

Overfished (listed in each assessment as projection scenario 6):

In all future years,  $F$  is set equal to  $F_{OFL}$ . (Rationale: This scenario determines whether a stock is overfished. If the stock is expected to be 1) above its MSY level in 2022 or 2) above 1/2 of its MSY level in 2022 and above its MSY level in 2032 under this scenario, then the stock is not overfished.)

Approaching an overfished condition (listed in each assessment as scenario 7):

In 2023 and 2024,  $F$  is set equal to  $\max F_{ABC}$ , and in all subsequent years,  $F$  is set equal to  $F_{OFL}$ . (Rationale: This scenario determines whether a stock is approaching an overfished condition. If the stock is 1) above its MSY level in 2024 or 2) above 1/2 of its MSY level in 2024 and expected to be above its MSY level in 2034 under this scenario, then the stock is not approaching an overfished condition.)



For stocks in Tiers 4-6, no determination can be made of overfished status or approaching an overfished condition as information is insufficient to estimate the MSY stock level.

### Overview of Stock Assessments

The status of individual groundfish stocks managed under the FMP is summarized in this section. The spawning biomass estimates of pollock (W/C GOA), sablefish, Dover sole, flathead sole, rex sole, arrowtooth flounder, Pacific ocean perch, roughey and blackspotted rockfish, northern rockfish, and dusky rockfish are above target stock size (Fig. 2). The spawning biomass of Pacific cod is below the proxy for  $B_{MSY}$ . The target biomass levels for EGOA pollock, deep-water flatfish (excluding Dover sole), shallow-water flatfish, shorttraker rockfish, other rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, skates, octopus, and sharks are unknown.

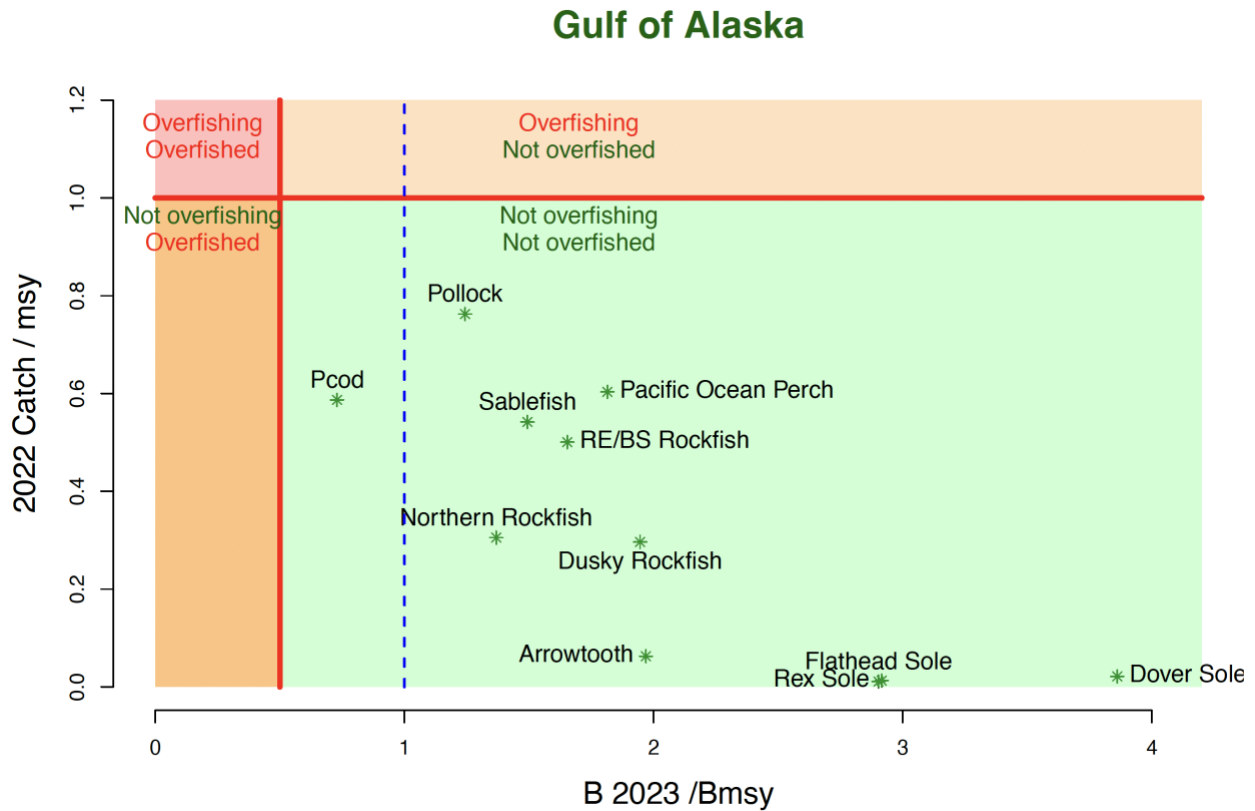


Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to  $B_{MSY}$ ; horizontal axis) and current year catch relative to fishing at  $F_{MSY}$  (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

### Summary and Use of Terms

Table 1 provides a summary of the status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2022, and recommendations for ABCs and overfishing levels (OFLs) for 2023 and 2024. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. For 2023 and 2024, the Plan Team did not have any ABC recommendations that were below the maximum permissible.

The sum of the Plan Team’s recommended 2023 ABC for target species in the GOA (excluding sablefish, for which ABC is set Alaska-wide) is 498,570 t (508,685 t for 2024). The sums of the Plan Team’s recommended 2023 and 2024 OFLs (again, excluding sablefish) are 599,436 and 609,750 t, respectively. For perspective, the sum of the 2022 TACs, not including the 2022 sablefish TAC, was 425,324 t and the

sum of the ABCs was 473,790 t (and catch through November 5th, 2022, without sablefish was 204,144 t). The sum of GOA total TAC from 2022, including the GOA sablefish TAC of 22,794 t is 448,118 t, which is within FMP-approved optimum yield (OY) of 116,000 - 800,000 t for the Gulf of Alaska.

The following conventions in this SAFE are used:

- 1) “Fishing mortality rate” refers to the full-selection  $F$  (i.e., the rate that applies to fish of fully selected sizes or ages). A full-selection  $F$  should be interpreted in the context of the selectivity schedule to which it applies.
- 2) For consistency and comparability, “exploitable biomass” refers to projected age+ biomass, which is the total biomass of all cohorts greater than or equal to some minimum age. The minimum age varies from species to species and generally corresponds to the age of recruitment listed in the stock assessment. Trawl survey data may be used as a proxy for age+ biomass. The minimum age (or size), and the source of the exploitable biomass values are defined in the summaries. These values of exploitable biomass may differ from values listed in the corresponding stock assessments if the technical definition is used (which requires multiplying biomass at age by selectivity at age and summing over all ages). In those models assuming knife-edge recruitment, age+ biomass and the technical definitions of exploitable biomass are equivalent.
- (3) The values listed as 2021 and 2022 ABCs correspond to the values (in metric tons, abbreviated “t”) approved by NMFS. The Council TAC recommendations for pollock were modified to accommodate revised area apportionments in the measures implemented by NMFS to mitigate pollock fishery interactions with Steller sea lions and for Pacific cod removals by the State water fishery of not more than 25% of the Federal TAC. The values listed for 2023 and 2024 in the SAFE introduction correspond to the Plan Team recommendations, while values within each SAFE chapter correspond to author recommendations.
- (4) The exploitable biomass for 2021 and 2022 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2023 biomass with previous years’ levels should be made with biomass levels from the revised hindcast reported in each assessment.
- (5) The catches listed in the following summary tables are those reported by the Alaska Regional Office Catch Accounting System (<https://www.fisheries.noaa.gov/alaska/commercial-fishing/fisheries-catch-and-landings-reports-alaska#goa-groundfish>) unless otherwise noted.
- (6) The values used for 2023 and 2024 were from modified assessments for selected species, rolled over (typically for Tiers 4-6) or based on updated projections. Note that projection values often assume catches and hence their values are likely to change (as are the Tiers 4-6 numbers when new data become available and/or is incorporated in the assessment).

#### *Two-year OFL and ABC Determinations*

Amendment 48/48 to the GOA and BSAI Groundfish FMPs, implemented in 2005, made a significant change with respect to the stock assessment process requiring proposed and final specifications for a period of at least two years. This requires providing ABC and OFL levels for the next two years in this cycle (Table 1). The 2023 harvest specifications (from Council recommendations in December 2021) are in place to start the fishery on January 1, 2023, but these will be replaced by final harvest specifications that will be recommended by the Council in December 2022. The final 2023 and 2024 harvest specifications will become effective when final rulemaking occurs in February or March 2023. This process allows the Council to use the most current survey and fishery data in stock assessment models for setting quotas for the next two years, while having no gap in harvest specifications.

The 2024 ABC and OFL values recommended in next year’s SAFE report are likely to differ from this year’s projections for 2024 because of new information (e.g., survey, projections) that is incorporated into

the assessments. In the case of stocks managed under Tier 3, ABC and OFL projections for the second year in the cycle are typically based on the output for Scenarios 1 or 2 from the standard projection model using assumed (best estimates) of total year catch levels. For stocks managed under Tiers 4-6, projections for the second year in the cycle are set equal to the Plan Team’s recommended values for the first year in the cycle.

*Revised Stock Assessment Schedule*

Based on consideration of stock prioritization including assessment methods and data availability, some stocks are assessed on an annual basis while others are assessed less frequently. The following table provides an overview of the level of assessment presented in this year’s SAFE report, the Tier level and schedule, as well as the year of the next full assessment by stock.

<b>Stock Assessment schedule for the Gulf of Alaska</b>				
<b>Stock</b>	<b>2022 Assessment status</b>	<b>Tier</b>	<b>Schedule (years)</b>	<b>Year of next Full Assessment</b>
Pollock	Full	3	1	2023
Pacific cod	Full	3	1	2023
Sablefish	Full	3	1	2023
Northern and southern rock sole	Partial	3	4	2025
Shallow water flatfish (excluding northern and southern rock sole)	Partial	5	4	2025
Deepwater flatfish (Dover)	Partial	3/6	4	2023
Rex sole	Partial	3	4	2025
Arrowtooth flounder	Partial	3	2	2023
Flathead sole	Full	3	4	2025 <sup>1</sup>
Pacific ocean perch	Partial	3	2	2023
Northern rockfish	Full	3	2	2024
Shortraker rockfish	None	5	2	2023
Other rockfish	None	4/5/6	2	2023
Rougheye & blackspotted rockfish	Partial	3	2	2023
Dusky rockfish	Full	3	2	2024
Demersal shelf rockfish	Full	4/6	2	2024
Thornyheads	Full	5	2	2024
Atka mackerel	None	6	2	2023
Octopus	None	6	2	2023
Skates	None	5	2	2023
Sharks	Full	6	2	2024
Sculpins	None	eco	4	2023
Forage species (including Squid)	Report	eco	2	2024
Grenadiers (BSAI/GOA)	None	eco	4	2024

<sup>1</sup> A full assessment for GOA flathead sole was scheduled for 2021, but due to limited staff resources, the full assessment was postponed until 2022. After the 2022 full assessment, the next full assessment for flathead sole will be the scheduled 2025 assessment, and then full assessments will continue on the normal 4-year cycle.

## **Economic Summary of the GOA commercial groundfish fisheries in 2020-2021**

The ex-vessel value of all Alaska domestic fish and shellfish catch, which includes the amount paid to harvesters for fish caught, and the estimated value of pre-processed fish species that are caught by catcher/processors, increased from \$1,520 million in 2020 to \$1,992 million in 2021 (real 2021\$). The first wholesale value of 2021 groundfish catch after primary processing was \$2,142 million, a decrease from the 2020 value of \$2,197 million. The 2021 total groundfish catch decreased by 4%, and the total first wholesale value of groundfish catch decreased by 2.5%, relative to 2020.

The groundfish fisheries accounted for the largest share (38%) of the ex-vessel value of all commercial fisheries off Alaska with \$760 million in revenue, while the Pacific salmon (*Oncorhynchus spp.*) fishery was second with \$729 million or 37% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to \$353 million or 18% of the total for Alaska and exceeded the value of Pacific halibut (*Hippoglossus stenolepis*) with \$128 million or 7% of the total for Alaska.

The Economic SAFE report (appendix bound separately) contains detailed information about economic aspects of the groundfish fisheries, including figures and tables, economic performance indices, and current year product price and ex-vessel price projections. The final version also presents an Amendment 80 fishery economic data report (EDR) summary, an Amendment 91 fishery economic data report (EDR), market profiles for the most commercially valuable species, and a Gulf Trawl economic data report. The report will now also include a section summarizing in-season harvest and revenue estimates for groundfish and halibut through Sept. 2022. The previous section covering community participation was moved into a separate report, the Annual Community Engagement and Participation Overview (ACEPO).

Data tables are organized into four relatively distinct sections: (1) All Alaska, (2) BSAI, (3) GOA, and (4) Pacific halibut. The figures and tables in the report provide estimates of total groundfish catch, groundfish discards and discard rates, prohibited species catch (PSC) and PSC rates, the ex-vessel value of the groundfish catch, the ex-vessel value of the catch in other Alaska fisheries, the gross product value of the resulting groundfish seafood products, the number and sizes of vessels that participated in the groundfish fisheries off Alaska, vessel activity, and employment on at-sea processors. Generally, the data presented in this report cover 2016-2021, but limited catch and ex-vessel value data are reported for earlier years to illustrate the rapid development of the domestic groundfish fishery in the 1980s and to provide an historical perspective on catch. The data behind the tables from this and past Economic SAFE reports are publicly available online at: <https://reports.psmfc.org/akfin> and <https://psesv.psmfc.org/PSESV-2/>.

### *Summary of wholesale ex-vessel and first wholesale changes in Gulf of Alaska revenues*

According to data reported in the current Economic SAFE report, the total real ex-vessel value of Gulf of Alaska (GOA) groundfish increased by 34% from \$97 million in 2020 to \$130 million in 2021 (Figure 3), and real first-wholesale revenues from the processing and production of groundfish in the GOA increased by 22% between 2020 (\$204 million) and 2021 (\$248 million) (Figure 4). The total quantity of groundfish products from the GOA decreased by 12% from 83 thousand metric tons to 73 thousand metric tons.

### *Decomposition of the change in first-wholesale revenues from 2020-2021 in the GOA*

The following brief analysis summarizes the overall nominal revenue changes that occurred from 2020-21 and the quantity produced, and revenue generated from GOA groundfish and how revenues have been impacted by changes in quantity or prices of each species and product group (Figure 5). Unlike the numbers above, these values are not adjusted for inflation, so enable a simple comparison of how changes in the price and quantity for each group combine to produce revenues.

By GOA species group, a large positive quantity effect resulted in a positive net effect of about \$20.7 million for Pacific cod (Figure 5, top panel). For pollock, smaller price and quantity effects offset each other, which resulted in almost zero change to first wholesale revenues for 2020-21 (Figure 5). There were small positive price and quantity effects for rockfish that combined for a net positive effect of \$7.6 million. Atka mackerel did not exhibit much change, with a positive increase of less than \$1 million.

Flatfish had a small positive price effect combined with a negative quantity effect that resulted in a net revenue decrease, equal to \$8.9 million. Sablefish had a positive price effect, and a very strong quantity effect, combining for a net positive effect of \$32.3 million. The “Other” species group experienced a net revenue decrease of less than \$1 million.

By product group, a small positive price effect coupled with large positive quantity effect for fillets resulted in a positive net effect of \$23.9 million in the GOA first-wholesale revenue decomposition for 2020-21 (Figure 5, bottom panel). For surimi, small positive price and quantity effects resulted in a positive net effect of almost \$4 million. For roe, a small positive price effect coupled with a small negative quantity effect resulted in a positive net effect of \$1.4 million. For whole fish and head & gut, a strong positive price effect combined with a positive quantity effect produced a net positive effect of \$19.5 million. For ‘other’ products, a small positive price effect combined with a positive quantity effect resulted in a net positive effect of \$3.2 million.

In summary, the changes in first-wholesale revenues from the GOA groundfish fisheries increased significantly in value from 2020-21 due to positive price effects for all species and products, which were concentrated in the whole head & gut product, and very strong quantity effects for sablefish and Pacific cod.

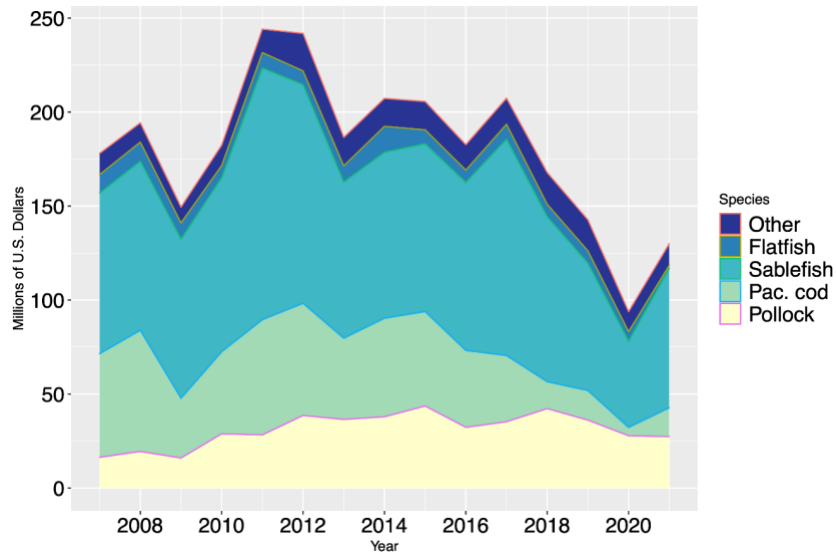


Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2007-2021 (base year = 2021).

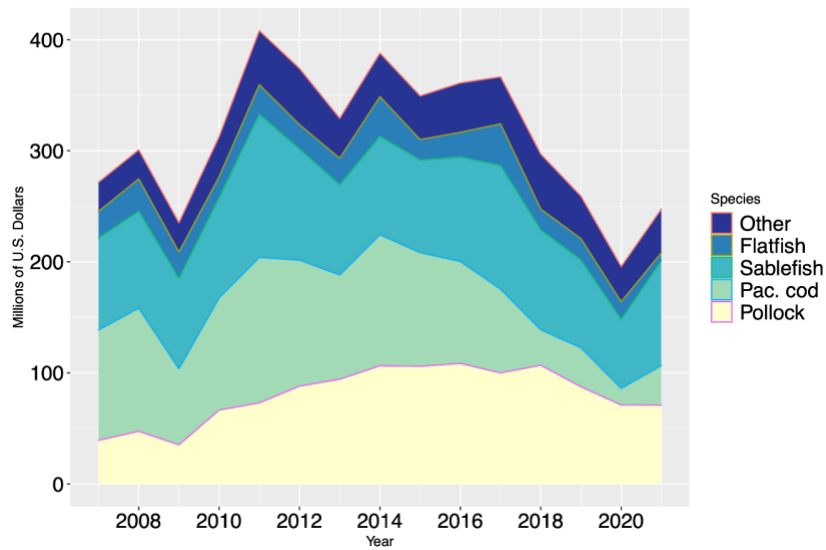


Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2007-2021 (base year = 2021).

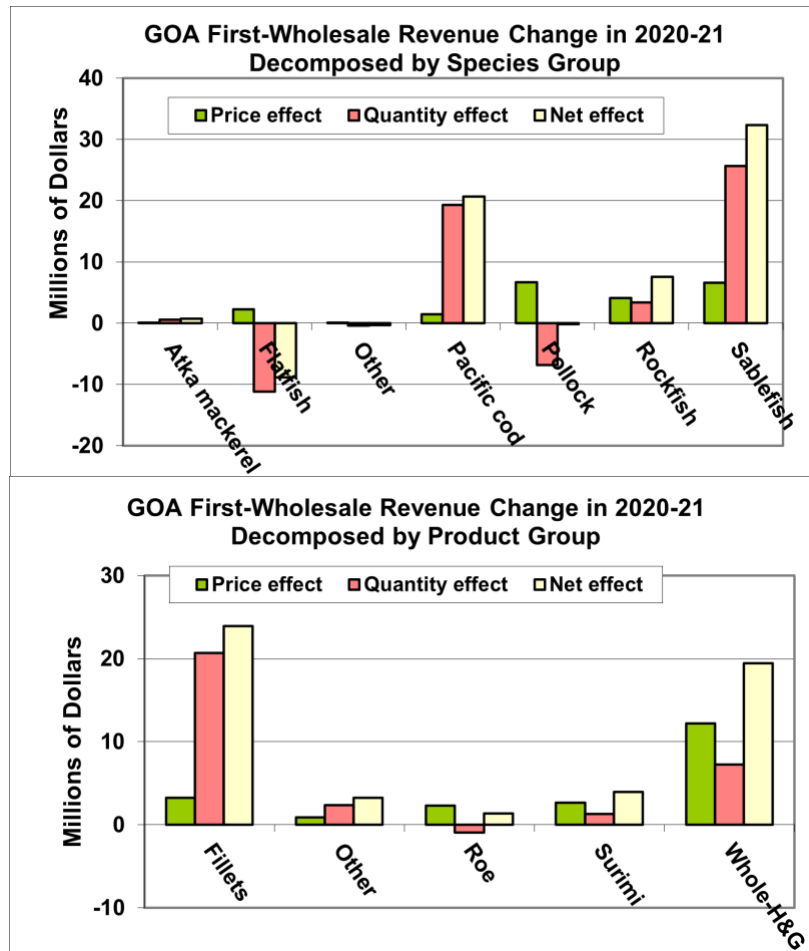


Figure 5. Decomposition of the change in first-wholesale revenues from 2020-21 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the first-wholesale price index (current dollars per metric ton) for each group. The quantity effect refers to the change in revenues due to the change in production (in metric tons) for each group. The net effect is the sum of price and quantity effects. Year-to-year changes in the total quantity of first-wholesale groundfish products include changes in total catch and the mix of product types (e.g., fillet vs. surimi).

## Ecosystem Considerations summary

### *Western Gulf of Alaska 2022 Report Card*

- Winter average PDO index (Dec.-Feb., 1980–2022) continued its negative trend in 2022, reflecting cooling sea surface temperatures in the GOA.
- Sea-surface temperatures in the summer (°C) (Jun.-Aug., 1985–2022) 2022 in the western GOA were warmer than average, but remained within 1SD of the long-term mean.
- Copepod biomass ( $\text{g m}^{-3}$ ) was approximately average (1998–2022) in 2022, indicating potentially average foraging conditions for planktivorous predators. Total (large and small) calanoid copepods are surveyed south of Seward in May of each year.

- Copepod community size (ratio of large calanoid copepods to total calanoid copepods) remained elevated in 2022, approximately 1SD above average (1998–2022), indicating increased large copepods in the community, relative to small copepods. Total (large and small) calanoid copepods are surveyed south of Seward in May of each year.
- Motile epifauna biomass (1,000 t), observed during 2021 the NOAA Fisheries bottom trawl survey (May-Aug., 1984–2021), decreased from 2019 to 2021 but remains within 1SD of the long-term mean. The biomass of this guild is dominated by octopuses, hermit crabs, and brittle stars. Hermit crabs, brittle stars, and octopus are below their long-term means while other echinoderms are above their long-term mean.
- Capelin abundance (proportion of diet by weight), as sampled by rhinoceros auklets at Middleton Island (Apr.-Aug., 1986–2022), continue to be minimal in seabird chick diets in recent years, but still remain within 1SD of the long-term mean.
- Fish apex predator biomass (1,000 t), observed during 2021 the NOAA Fisheries bottom trawl survey (May-Aug., 1984–2021), increased from 2019 to 2021 to within just above 1SD below the long-term mean. The primary species driving these trends include Pacific cod biomass, continuing to stay above their low in 2017, but remain below their long-term mean, Arrowtooth flounder, which has trended upward since their low in 2017 but also remain below their long-term mean, and sablefish which are well above their long-term mean.
- Black-legged kittiwakes reproductive success in 2022 (Jun.-Jul., 1980–2022) increased to 1SD above the long-term mean at the Semidi Islands, potentially, indicating above-average prey availability for these surface-feeding, piscivorous seabirds.
- Western Gulf of Alaska Steller sea lion non-pup model predicted counts continued a slightly decreasing trend from previous years, remaining within 1SD of the long-term mean (1980–2021). These data have not been updated since 2021.

#### *Eastern Gulf of Alaska 2022 Report Card*

- Multivariate ENSO Index was negative, La Niña conditions, in the winter of 2021/2022 (Dec./Jan., 1980-2022). A third consecutive winter of La Niña conditions are predicted for winter 2022/2023.
- Sea-surface temperatures (°C) in the summer of 2022 (Jun.-Aug.), were above average (1985–2022) in the eastern GOA, and close to 1SD above the long-term mean.
- Total zooplankton density (# m<sup>-3</sup>) in southeastern Alaska inside waters (May-Aug., 1988–2022) increased to above 1SD of the long-term mean, driven by large and small calanoid copepods. This suggests above-average foraging conditions for planktivorous fish, seabirds, and mammals.
- Copepod community size (ratio of large calanoid copepods to total calanoid copepods) remained approximately average in 2022 (May-Aug., 1997–2022). The copepod community is sampled in Icy Strait (southeast Alaska Inside waters).
- Motile epifauna biomass (1,000 t), observed during 2021 NOAA Fisheries bottom trawl survey (May-Aug., 1984–2021), decreased from 2019 to 2021 but remains within 1SD of the long-term mean. Hermit crabs, brittle stars, and other echinoderms are all below their long-term means. Eelpouts have also decreased from 2019 to 2021 but remain above their long-term mean.
- Estimated total mature herring biomass (age 3+) of Sitka herring in spring 2022 remains 1 SD above average (1980–2022) continuing a 4-year trend of the largest value in the timeseries (since 1980). The two populations with ocean influence (Sitka Sound and Craig) were elevated while populations in southeastern AK inner waters and Prince William Sound increased but remained low.



- Fish apex predator biomass (1,000 t), observed during 2021 NOAA Fisheries bottom trawl survey (May-Aug., 1984–2021), trended downward from a high in 2015 to their second lowest value over the time series in 2021, but remaining just within 1SD of the long-term mean. The decrease over this time period has largely been driven by arrowtooth flounder which are at their lowest value over the time series, more than one standard deviation below their long-term mean. Pacific halibut, sablefish, and Pacific cod, have all increased from 2019 and are above their long-term means.
- Growth rates of piscivorous rhinoceros auklet chicks ( $\text{g d}^{-1}$ ) remain 1SD below the long-term mean in 2022 (Jun.-Jul., 1995–2022), but continue a multi-year increasing trend.
- Eastern Gulf of Alaska Steller sea lion non-pups model predicted counts continue a decreasing trend, but remain above 1SD of the long-term mean (1980–2021) through 2021. However, counts suggest that non-pup have been lower than predicted in 2019 and 2017. These data have not been updated since 2021.

One item was highlighted as Noteworthy (formerly “hot topics”) for the GOA this year:

Invasive European green crab *Carcinus maenas*, hereafter referred to as invasive green crab, were observed in Alaska for the first time, on Annette Island in Southeast Alaska; their presence was confirmed, July 2022. The observations were the result of early detection monitoring for the aquatic invasive species by the Metlakatla Indian Community’s Fish and Wildlife department, in anticipation of the species’ continued northward expansion originating from San Francisco Bay. NOAA Fisheries, Alaska Region began supporting this effort in 2020 after adult green crabs were found in Skidegate Inlet, Haida Gwaii, British Columbia. As a new invasive species in the Gulf of Alaska, the potential impact of green crabs at population scales is still negligible, but they have the potential to disrupt local, intertidal systems. There are no published reports of green crab directly impacting groundfish populations. However, given their documented impacts in other regions, it will be important to monitor the direct and indirect effects on the broader marine ecosystem as they expand into the Gulf of Alaska.

## Stock summaries

### 1. [Walleye pollock](#)

Status and catch specifications (t) of pollock and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year (age 3+ for W/C/WYAK and survey biomass for SEO). The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data were through November 5<sup>th</sup>, 2022.

The GOA-wide and W/C/WYAK ABCs listed in this table are before reductions for the Prince William Sound GHL. However, the federal TACs from earlier years reflect reductions from the ABC due to State waters GHL. State waters GHL was computed as 2.5% of the total W/C/WYAK ABC.

Area	Year	age-3+ Biomass	OFL	ABC	TAC	Catch
W/C/WYAK	2021	1,097,340	123,455	111,134	108,491	104,163
	2022	848,878	154,983	139,803	136,476	136,317
	2023	1,281,980	173,470	148,938		
	2024		186,101	161,080		
SEO	2021	45,103	13,531	10,148	10,148	0
	2022	50,500	15,150	11,363	11,363	0
	2023	50,500	15,150	11,363		
	2024		15,150	11,363		
GOA-wide	2021	1,142,443	136,986	115,870	113,227	99,019
	2022	899,378	170,133	144,444	141,117	129,876
	2023	1,332,480	188,620	160,301		
	2024		201,251	172,443		

#### *Changes from the previous assessment*

This year's pollock assessment features the following new data: 1) 2021 total catch and catch-at-age from the fishery, 2) 2022 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2021 NMFS Bottom Trawl survey age composition, 4) 2021 Summer GOA-wide acoustic survey age composition, and 5) 2022 biomass from the ADF&G crab/groundfish trawl survey.

Two minor changes to the model included adding a penalty to the recruitment deviations for all years and estimating selectivity of the summer acoustic survey, culminating in Model 19.1a.

#### *Spawning biomass and stock trends*

While the model and data changes increased the scale of spawning biomass in comparison to last year's assessment, the spawning stock is projected to decline in 2023 and 2024 as the 2012 year-class is further reduced in abundance. The presence of several incoming year classes should result in a stabilization in biomass. The 2017 year-class is still present in high numbers in both the fishery and surveys, and the 2018 year-class continues to be present in the Shelikof Strait survey. There is also emerging evidence of a larger than average 2020 year-class. The Shelikof Strait survey data in 2022 showed slight decrease in biomass compared to 2021. Overall, survey indices seem to be providing similar trends with closer agreement among the surveys.

#### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

The model projection of female spawning biomass in 2023 is 204,554, which is above  $B_{40\%}$  (188,000), which places the W/C/WYAK Gulf of Alaska pollock stock in Tier 3a. The Team supported the authors' recommendation using the assessment-derived maximum permissible ABC for 2023. The resulting 2023 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is a 12 % increase from the 2022 ABC. Pollock in southeast Alaska (East Yakutat and Southeastern areas) are in Tier 5 and unchanged from last year. The recommendations are based on natural mortality (0.3) and the random effects model fit to the 1990-2021 bottom trawl survey biomass estimates in Southeast Alaska.

### *Status determination*

The Gulf of Alaska pollock stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

### *Area apportionment*

The assessment was updated to include the most recent data available for area apportionments within each season (Appendix 1D.3 of the GOA pollock chapter). For winter seasons, model estimates of biomass for winter acoustic surveys conducted were used as a basis for apportionment. Apportionments for the B1 and B2 seasons were based on a 3-year weighted average of the sum of the AFSC bottom trawl survey and the gulf-wide acoustic summer survey (unchanged from the previous assessment). Area apportionments, including the 2.5% of the ABC for the State of Alaska managed pollock fishery in Prince William Sound, are as follows:

Year	W (610)	C (620)	C (630)	WYAK	EYAK/SEO	PWS GHL	Total
2023	26,958	77,005	33,729	7,523	11,363	3,723	160,301
2024	29,156	83,283	36,478	8,136	11,363	4,027	172,443

## **2. Pacific cod**

Status and catch specifications (t) of Pacific cod in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5<sup>th</sup>, 2022.

Year	age-0+ Biomass	OFL	ABC	TAC	Catch
2021	255,661	28,977	23,627	17,321	13,281
2022	178,961	39,555	32,811	24,111	18,275
2023	163,477	29,737	24,634		
2024		27,507	22,683		

### *Changes from the previous assessment*

Data updated for the 2022 assessment included federal and state catch data for 2021, preliminary federal and state catch data for 2022, commercial federal and state fishery size composition data for 2021, and preliminary commercial federal and state fishery size composition data for 2022. The AFSC longline survey Pacific cod abundance index and length composition data for the GOA for 2022, the AFSC bottom trawl survey conditional length-at-age data for 2021, commercial federal conditional length-at-age data for 2021 were included, and commercial state catch from 1997 – 2002 were added to the model's catch time series. The AFSC longline survey Relative Population Number index in 2022 compared to 2021 declined by 24%.

The model used for 2022 (Model 19.1a) is last year's accepted model (Model 19.1) with the inclusion of commercial state catch data described above. There were no other model changes made in this year's assessment.

### *Spawning biomass and stock trends*

The B<sub>40%</sub> estimate was 66,966 t, with projected 2023 spawning biomass of 42,764 t. Spawning biomass is projected to slightly decrease from 2023 to 2024.

*Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Based on previous classification of this stock being in Tier 3, the 2023 spawning biomass was projected to be at  $B_{25.5\%}$ , therefore below  $B_{40\%}$  and classified as Tier 3b. The  $F_{OFL}$  and  $F_{ABC}$  values are 0.51 and 0.41, respectively. The Team agreed with the author’s recommended ABC and OFL. The recommended 2023 ABC is a 25% decrease from the 2022 ABC.

*Status determination*

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

*Area apportionment*

Since the 2014 assessment, the random effects model has been used for Pacific cod apportionment. Using this method with the trawl survey biomass estimates through 2021, the author and the Team recommended area-apportioned ABCs are:

Year	Western	Central	Eastern	Total
2023	7,464	14,830	2,340	24,634
2024	6,873	13,655	2,155	22,683

**3. Sablefish**

Status and catch specifications (t) of sablefish in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Beginning in 2020, the OFL was specified Alaska-wide (for both BSAI and GOA). The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5<sup>th</sup>, 2022.

Area	Year	age-4+ Biomass	OFL	ABC	TAC	Catch
GOA Total	2021	390,000		21,475	17,992	15,508
	2022	240,600			22,794	17,531
	2023	317,000				
	2024					
AK Total	2021	707,000	60,426	29,588		21,255
	2022	529,800	40,432	34,521		24,929
	2023	621,000	47,390	40,502		
	2024		48,561	41,539		

*Changes from the previous assessment*

New data in the assessment model included relative abundance and length data from the 2022 longline survey, length data from the fixed gear fishery for 2021, length data from the trawl fisheries for 2021, age data from the longline survey and fixed gear fishery for 2021, updated catch for 2021, and projected 2022- 2024 catches. Estimates of killer and sperm whale depredation in the fishery were updated and projected for 2022-2024. Fixed gear fishery catch-per-unit effort (CPUE) data from logbooks and observers were updated through 2021 (including the 2020 data that was not available for the 2021 SAFE) and the CPUE index was updated through 2021.

No changes were made to the assessment methodology and model 21.12 was utilized as described in the 2021 SAFE. However, Francis data reweighting was performed to account for the new data available in 2022, which resulted in slightly different data weights from the 2021 model.

#### *Spawning biomass and stock trends*

Survey abundance and biomass indices continued to increase in 2022. The longline survey abundance index increased by 17% in 2022 following a 9% increase in 2021 and a 32% increase in 2020. The biennial trawl survey biomass index has increased nearly five-fold since 2013, with a 40% increase from 2019 to 2021. The data and model indicate strong year classes from 2014, 2016, 2017, 2018, and now in 2019, as well. Based on the strength of these recent year classes, age-2+ biomass has almost tripled from a time series low of 228,000 t in 2015 to 665,000 t in 2022, sablefish population levels that have not been estimated since the early 1970s. Although growth in SSB has lagged compared to total biomass, given that recent year classes are not fully mature, SSB has still increased by 60% from the time series low of 84,000 t in 2017 to 134,000 t in 2022. Thus, the current SSB is at 44% of the unfished SSB (i.e., SSB<sub>0</sub>) in 2022. However, the lack of sablefish greater than 10 years of age (i.e., the age when sablefish are greater than 90% mature) remains concerning for such an extremely long-lived species and needs to be carefully monitored. As recent year classes grow towards full maturity, the population age structure is beginning to expand. It is important that each of these cohorts can survive in large numbers to fully mature ages to ensure long-term productivity.

#### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Sablefish are managed under Tier 3 of the NPFMC harvest control rule that primarily aims to maintain the population at  $B_{40\%}$ . Since projected female spawning biomass (combined areas) for 2023 is equivalent to  $B_{52\%}$ , sablefish is in sub-tier “a” of Tier 3. Spawning biomass is projected to increase rapidly in the near-term, and the maximum permissible value of FABC under Tier 3a is 0.081, which translates into a 2023 maximum permissible ABC (combined areas) of 40,861 t. The OFL fishing mortality rate is 0.096, which translates into a 2023 OFL (combined areas) of 47,857 t. Adjusting for estimated whale depredation, the 2023 combined areas ABC is 40,502 t. The Teams agreed with these recommendations.

#### *Status determination*

This stock is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

#### *Area apportionment*

In 2013, the Plan Team and SSC agreed that a fixed apportionment scheme was acceptable. In 2020, results of a simulation analysis resulted in recommending a five-year average survey apportionment method. The authors continue to recommend this approach and the Teams agreed. In 2021, the SSC recommended a phased transition to this method. This year, the authors noted that the SSC procedure would mean a “75% stair step” from the 2020 fixed apportionment values towards the 2022 five-year average survey apportionment. This gives the following area-specific ABCs (including deductions for estimated whale depredation):

Region	2022			2023		2024	
	OFL <sub>w</sub>	ABC <sub>w</sub>	TAC	OFL <sub>w</sub>	ABC <sub>w</sub>	OFL <sub>w</sub>	ABC <sub>w</sub>
BS	--	5,264	5,264	--	8,417	--	10,145
AI	--	6,463	6,463	--	8,884	--	10,299
<b>BSAI<sup>1</sup></b>	--	<b>11,727</b>	<b>11,727</b>	--	<b>17,301</b>	--	<b>20,444</b>
<b>GOA</b>	-	<b>22,794</b>	<b>22,794</b>	--	<b>23,201</b>	--	<b>21,095</b>
<b>Alaska-wide</b>	<b>40,432</b>			<b>47,390</b>	<b>40,502</b>	<b>48,561</b>	<b>41,539</b>

<sup>1</sup>BSAI information included to show total breakdown. For details please see the BSAI SAFE Intro document.

Year	Western	Central	WYAK*	SEO*	GOA Total	AK Total
2023	4,473	9,921	3,205	5,602	23,201	40,502
2024	4,626	8,819	2,669	4,981	21,095	41,539

\*95:5 split in the EGOA following the trawl ban in SEO

#### 4. [Shallow water flatfish \(partial\)](#)

Status and catch specifications (t) of shallow water flatfish and projections for 2023 and 2024. The shallow water flatfish (SWF) complex comprises of northern rock sole, southern rock sole, yellowfin sole, butter sole, starry flounder, English sole, sand sole and Alaska plaice. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are through November 5th, 2022.

Year	Biomass	OFL	ABC	TAC	Catch
2021	342,226	68,841	56,164	45,263	1,857
2022	442,424	62,273	50,610	42,604	1,294
2023	449,607	65,736	53,537		
2024		68,015	55,474		

##### *Changes from the previous assessment*

[Northern and southern rock sole](#) are Tier 3a species and assessed separately from the other shallow water flatfish, which are Tier 5. The shallow water flatfish stock complex is on a 4-year assessment cycle; the last full assessment was completed in 2021. Separate assessment models were developed for northern and southern rock sole, and two-area models were developed for each species due to growth differences between the central and western Gulf of Alaska. The rock sole models included recent fishery catch and survey results. This year, the authors presented a partial assessment consisting of an executive summary including recent fishery catch, survey results, and recommend harvest levels for 2023 and 2024.

##### *Spawning biomass and stock trends*

The shallow-water flatfish complex 2023 biomass estimate is a (2%) increase from the 2022 biomass estimate. Overall, biomass for shallow water flatfish is stable. Both northern and southern rock sole biomass and spawning biomass estimates show increasing trends.

##### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Northern and southern rock sole are in Tier 3a while the other species in the complex are in Tier 5. The OFL and ABC estimated for SWF species other than the rock soles were added to the management advice

from the 2022 projection model for northern rock sole and southern rock sole to provide a SWF complex OFL and ABC. The Team agreed with author recommendations.

*Status determination*

Information was insufficient to determine stock status relative to overfished criteria for the complex. For the rock sole species, the assessment model indicates they are not overfished nor are they approaching an overfished condition. Catch levels for this complex remain below the TAC and below levels where overfishing would be a concern.

*Area apportionment*

The recommended apportionment percentages based on the random effects model applied to survey biomass estimates (including the 2021 GOA survey) for ABC are:

Year	Western	Central	WYAK	EYAK/SEO	Total
2023	22,486	26,768	2,677	1,606	53,537
2024	23,299	27,737	2,774	1,664	55,474

**5. Deepwater flatfish complex (partial)**

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2023 and 2024. Biomass for each year is for Dover sole only and corresponds to the model estimate associated with the ABC for that year. Catch data are current through November 5th, 2022.

Year	Biomass	OFL	ABC	TAC	Catch
2021	84,771	7,040	5,926	5,926	95
2022	83,131	7,026	5,908	5,908	122
2023	81,328	6,918	5,816		
2024		6,802	5,719		

*Changes from the previous assessment*

The deepwater flatfish complex is comprised of Dover sole, Greenland turbot, Kamchatka flounder, and deepsea sole. A full assessment for the Gulf of Alaska deepwater flatfish complex was conducted in 2019. Projections were run and updated numbers were used for 2023 specifications.

*Spawning biomass and stock trends*

The model estimate of 2023 spawning stock biomass for Dover sole is 25,717 t, which is well above  $B_{40\%}$  (7,613 t). Spawning stock biomass and total biomass are expected to remain stable through 2024. Stock trends for Greenland turbot, Kamchatka flounder, and deepsea sole are unknown.

*Tier determination/Plan Team discussion and resulting ABCs and OFLs*

For ABC/OFL calculations, a Tier 3a approach was used for Dover sole and Tier 6 approaches were used for Greenland turbot, Kamchatka flounder, and deepsea sole. OFLs and ABCs for the individual species in the deepwater flatfish complex are determined and then summed for calculating complex-level OFLs and ABCs. The Team agreed with the author’s recommended ABC and OFL.

*Status determination*

The Gulf of Alaska Dover sole stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Information is insufficient to determine stock status relative to overfished criteria for Greenland turbot, Kamchatka flounder, and deepsea sole. Since Dover sole

comprises approximately 96% of the deepwater flatfish complex they are considered the main component for determining the status of this stock complex. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern.

*Area apportionment*

The random effects model is used to determine area apportionment for Dover sole as recommended by the Team in 2016. The Greenland turbot, Kamchatka flounder, and deepsea sole portion of the apportionment is based on the relative proportion of survey biomass of these species found in each area, averaged over the years 2001–2021. The ABC by area for the deepwater flatfish complex is the sum of the species-specific portions of the ABC. The area apportionment for 2023 and 2024 are as follows:

Year	Western	Central	WYAK	SEO	Total
2023	256	2,105	1,407	2,048	5,816
2024	255	2,068	1,383	2,013	5,719

**6. Rex sole (partial)**

Status and catch specifications (t) of rex sole and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th, 2022.

Year	age-3+ Biomass	OFL	ABC	TAC	Catch
2021	101,244	18,779	15,416	15,416	301
2022	124,543	23,302	19,141	19,141	694
2023	127,297	25,135	20,664		
2024		25,652	21,097		

*Changes from the previous assessment*

This stock is on a four-year cycle and a full assessment was conducted in 2021. This year a partial assessment was presented. The projection model was run using updated catches.

*Spawning biomass and stock trends*

The 2022 spawning biomass estimate increased slightly from 2021 and projected to slightly increase through 2023.

*Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Projected 2022 female spawning stock biomass is above  $B_{40\%}$ , therefore rex sole are in Tier 3a. The Team agreed with the author’s recommended ABC and OFL from the updated model.

*Status determination*

Gulf of Alaska rex sole is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Catches are below TACs and below levels where overfishing would be a concern.

*Area apportionment*

Area apportionments of rex sole ABCs for 2023 and 2024 are based on the random effects model applied to GOA bottom trawl survey biomass in each area. The ABCs calculated for the Western/Central area (based on model estimates) are apportioned based on random effects model predictions of the proportion of survey biomass in Western/Central and the Eastern area ABCs (based on model estimates) are



apportioned based on random effects model predictions of the proportion of survey biomass in the West Yakutat and Southeast areas, respectively.

Year	Western	Central	WYAK	SEO	Total
2023	3,236	13,110	1,439	2,879	20,664
2024	3,314	13,425	1,453	2,905	21,097

## 7. Arrowtooth flounder (partial)

Status and catch specifications (t) of arrowtooth flounder and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 5th, 2022.

Year	age-1+ Biomass	OFL	ABC	TAC	Catch
2021	1,321,700	151,723	126,970	97,372	9,984
2022	1,268,140	143,100	119,779	96,501	11,456
2023	1,265,950	142,749	119,485		
2024		141,008	118,015		

### *Changes from the previous assessment*

Arrowtooth flounder are assessed on a biennial schedule to coincide with the timing of survey data. The last assessment was presented in 2021. This off-cycle (even) year partial assessment consisted of an executive summary with recent fishery catch and survey trends as well as recommend harvest levels for the next two years. There were no changes to the assessment methodology.

### *Spawning biomass and stock trends*

The SSB projection for age 1+ for this stock is expected to be between 1.268 and 1.269M t during 2022-2024. There has been a 16% decrease in the longline survey, which is below the long-term average. Catch / biomass has increased 22% from last year but the resulting value is still among the lowest in the time series.

### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

This stock is in tier 3a. The *rema* R package will be used for apportionment of arrowtooth flounder in the next full assessment. The Team agreed with the author's recommended ABC and OFL.

### *Status determination*

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished.

### *Area apportionment*

Area apportionments of arrowtooth flounder ABCs for 2023 and 2024 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2023	30,469	65,000	7,886	16,130	119,485
2024	30,093	64,200	7,789	15,932	118,014

## 8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 5th, 2022.

Year	age-1+ Biomass	OFL	ABC	TAC	Catch
2021	280,980	47,982	39,377	28,392	707
2022	279,975	48,928	40,175	27,437	563
2023	294,188	48,161	39,480		
2024		49,073	40,222		

### *Changes from the previous assessment*

The flathead sole stock is assessed on a four-year schedule. Due to limited staff resources, the full stock assessment planned for last year was postponed until this year. No new models were considered this year. The previously accepted model was updated with new data and the modeling software was bridged from Stock Synthesis v3.24u to v3.30.17.

### *Spawning biomass and stock trends*

The 2023 spawning biomass estimate decreased slightly from 2022 but is well above B40% and projected to remain stable through 2024. Total biomass (age 3+) increased in 2023 and is projected to decrease slightly in 2024.

### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Flathead sole are determined to be in Tier 3a. The Team agreed with the authors' recommendation to use the maximum permissible 2023 ABC and OFL values. The ABC is a 1% decrease from last year.

### *Status determination*

This stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

### *Area apportionment*

The following tables show the recommended apportionment for 2023 and 2024 ABCs from the random effects model.

Year	Western	Central	WYAK	SEO	Total
2023	12,793	21,487	2,320	2,880	39,480
2024	13,033	21,892	2,363	2,934	40,222

## 9. Pacific ocean perch (partial)

Status and catch specifications (t) of Pacific ocean perch and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model. Catch data are current through November 5th, 2022.

Year	age-2+ Biomass	OFL	ABC	TAC	Catch
2021	613,522	42,977	36,177	36,177	28,900
2022	650,832	45,580	38,268	38,268	28,943
2023	636,129	44,302	37,193		
2024		43,117	36,196		

### *Changes from the previous assessment*

This year was a partial assessment so there was no change to the assessment model methodology. New data added to the projection model included updated catch data from 2021 and new estimated catches for 2022-2024. To more accurately estimate future catch, an updated yield ratio of 0.83 was computed using the average of the ratio of catch to ABC for the last three complete catch years (2019-2021). The updated yield ratio was then multiplied against the projected ABCs for 2023 and 2024 from the 2021 assessment model to estimate future catches.

### *Spawning biomass and stock trends*

The estimate of spawning biomass for 2023 (210,795 t) is above B40% and is projected to decrease slightly in 2024.

### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Pacific ocean perch are estimated to be in Tier 3a. The Team agreed with the authors' recommendation to use the maximum permissible 2023 ABC and OFL values. This ABC is a 3% decrease from last year.

### *Status determination*

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

### *Area apportionment*

The following tables show the recommended apportionment for 2023 and 2024 ABCs from the random effects model.

Year	Western	Central	Eastern	Total
2023	2,529	29,940	4,724	37,193
2024	2,461	29,138	4,597	36,196

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The Team and authors consider the biomass in the W. Yakutat area (between 147° W and 140° W) to be fishable, and therefore estimate the proportion of biomass in this sub-region for ABC considerations. The proportion of biomass between the W. Yakutat and E. Yakutat/Southeast areas is unchanged from the 2021 assessment, and resulted in the following ABC apportionment of the Eastern Gulf area:

Year	WYAK	SEO	Total
2023	1,370	3,354	4,724

Year	WYAK	SEO	Total
2024	1,333	3,264	4,597

The following table shows the apportionment of OFL between the Western/Central/W. Yakutat and E. Yakutat/Southeast WYK areas:

	Western/Central/W. Yakutat (W/C/WY)	E. Yakutat/Southeast (SEO)	Total
2023 Area OFL (t)	40,308	3,994	44,302
2024 Area OFL (t)	39,229	3,888	43,117

## 10. [Northern rockfish](#)

Status and catch specifications (t) of northern rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th, 2022.

Year	age-2+ Biomass	OFL	ABC	TAC	Catch
2021	102,715	6,396	5,358	5,357	2,377
2022	100,371	6,143	5,146	5,146	1,879
2023	95,452	5,927	4,964		
2024		5,661	4,741		

### *Changes from the previous assessment*

This was a full assessment and included data input and model changes. New data added to the model included bottom trawl survey biomass and age composition data for 2021, and updated catch composition data from 2022 (2,385 t), and new estimated catch for 2023. Model changes include removal of bottom trawl data from the 1980's and changing the terminal length group from 38 to 45 cm.

### *Spawning biomass and stock trends*

The 2023 spawning biomass estimate (39,445 t) is above  $B_{40\%}$  (32,940 t) and is projected to decrease to 37,470 t in 2024.

### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Northern rockfish are estimated to be in Tier 3a. The Team agreed with the authors' recommendation to use the maximum permissible 2023 ABC and OFL values. This ABC is a 3.5 % decrease from 2022 ABC.

### *Status determination*

This stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

### *Area apportionment*

Area apportionments of northern rockfish ABC's for 2023 and 2024 are based on the random effects model applied to GOA bottom trawl survey biomass estimates through 2021 for the Western, Central, and

Eastern Gulf of Alaska. Northern rockfish area apportionments for ABCs in 2023 and 2024 are shown below:

Year	Western	Central	Eastern*	Total
2023	2,614	2,350	1	4,965
2024	2,497	2,244	1	4,742

\* Note that the small northern rockfish ABC apportionments from the Eastern Gulf are combined with the other rockfish complex ABC in the West Yakutat management area for management purposes and are removed here from the Team recommended apportionments and ABC totals for northern rockfish.

### 11. Shortraker rockfish (no assessment)

In accordance with the approved schedule, no assessment was conducted for shortraker rockfish this year. However, a full stock assessment will be conducted in 2023. Until then, the values generated from the previous stock assessment (<https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAshortraker.pdf>) will be rolled over for 2023 specifications. Please refer to the last full stock assessment for details regarding the rolled-over estimates.

#### Tier 5

Year	Biomass	OFL	ABC	TAC	Catch
2021	31,465	944	708	708	528
2022	31,331	940	705	705	443
2023	31,331	940	705		
2024		940	705		

#### *Area apportionment*

For area apportionment of ABC, the random effects model was fit to area-specific biomass and proportions of survey biomass by area were calculated. The following table shows the rolled over recommended area apportionment (t) for 2023 and 2024.

Year	Western	Central	Eastern	Total
2023 and 2024	51 (7.3%)	280 (39.7%)	374 (53.0%)	705 (100.0%)

### 12. Dusky rockfish

Status and catch specifications (t) of dusky rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th, 2022.

Year	age-4+ Biomass	OFL	ABC	TAC	Catch
2021	97,702	8,655	5,389	5,389	2,928
2022	95,682	8,614	5,372	5,372	2,568
2023	107,160	9,638	7,917		
2024		9,154	7,520		

### *Changes in assessment methods and data*

This year a full assessment was completed for dusky rockfish with the main change in the treatment of bottom trawl survey data. Since 2015 this stock had adopted an original VAST treatment of the survey data with specifications that assumed a lognormal distribution for the positive catch rate tows instead of the gamma distribution. Survey biomass estimates were truncated at 1990+, and survey biomass indices from 1984 and 1987 were excluded. Survey biomass estimates, survey age compositions, and fishery size compositions were updated to 2021 data. Fishery age compositions were updated to 2020 data. Final catch values for 2020 and 2021 were included, as well as preliminary catch for 2022. Assessment methodology changes included extending the age plus group from age-25 to age-30, and extending the length plus group from 47 cm to 52 cm. The assessment model resulted in a sizeable increase in biomass and ABC value again.

### *Spawning biomass and stock status trends*

The estimates of spawning biomass for 2023 and 2024 from the projection model were 44,651 t and 44,651 t; well above the  $B_{40\%}$  estimate of 26,226 t. Catches have ranged from 2.1 to 3.3 thousand t over the last 10 years.

### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

The dusky rockfish stock is in Tier 3a. The Team concurred with the authors' recommended model and ABC and OFL values.

### *Status determination*

The stock is not being subjected to overfishing, is not currently overfished, nor is it approaching an overfished condition.

### *Area apportionment*

Apportionments are based on the random effects model applied to the trawl survey biomass estimates. The following table shows the recommended ABC apportionment for 2023 and 2024.

Year	Western	Central	Eastern	Total
2023	149	7,647	121	7,917
2024	141	7,264	115	7,520

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The ratio of biomass still obtainable in the W. Yakutat area (between 147° W and 140° W) is 0.74. This results in the following apportionment to the W. Yakutat area:

Year	WYAK	EYAK/SEO	Total
2023	90	31	121
2024	85	30	115

### 13. Rougheye and blackspotted rockfish (partial)

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current as of November 5th, 2022.

Year	age-3+ Biomass	OFL	ABC	TAC	Catch
2021	40,432	1,456	1,212	1,212	407
2022	26,060	947	788	788	438
2023	25,837	930	775		
2024		927	772		

#### *Changes from the previous assessment*

A full assessment for the Gulf of Alaska rougheye and blackspotted rockfish complex was conducted in 2021. This year was a partial assessment, and the authors updated the projection model with new catch information through October 15, 2022. This incorporates the most current catch information without re-estimating model parameters and biological reference points. Projections were run and updated numbers were used for 2023 specifications.

#### *Spawning biomass and stock status trends*

Estimated female spawning biomass for 2023 is 8,554 t. This is above the B<sub>40%</sub> value of 5,911 t.

#### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

The rougheye/blackspotted complex qualifies as a Tier 3 stock. For 2023 and 2024, the Team accepted the authors' recommended maximum permissible ABCs and the OFLs as provided in the table above.

#### *Status determination*

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished.

#### *Area apportionment*

The recommended apportionments for 2023 and 2024 are calculated using the two-survey random effects model, which was approved for use in this assessment in 2019. This method equally weights the longline and trawl survey indices.

Year	Western	Central	Eastern	Total
2023	180	232	363	775
2024	180	231	361	772

#### 14. Demersal shelf rockfish

Status and catch specifications (t) of GOA demersal shelf rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5, 2022.

Year	Biomass	OFL	ABC	TAC	Catch
2021	10,648	405	257	250	109
2022	12,388	579	365	358	163
2023	17,511	376	283		
2024		376	283		

For 2021–2024, the non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology. For 2021 and 2022, the yelloweye DSR ABCs and OFLs are calculated using Tier 4 methodology; for 2023 and 2024, the yelloweye DSR ABCs and OFLs are calculated using Tier 5 methodology. Non-yelloweye ABCs and OFLs are added to the yelloweye ABCs and OFLs for total DSR values.

##### *Changes from the previous assessment*

For this assessment cycle, the author recommended moving yelloweye component of the Demersal Shelf Rockfish (DSR) complex from a Tier 4 methodology to Tier 5. The non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology. Non-yelloweye Tier 6 ABCs and OFLs are added to the Tier 5 yelloweye ABCs and OFLs for total DSR values. This remains on a biennial assessment schedule with full assessments in odd years and partial stock assessments in even years. However, the last full assessment was completed in 2022 out of cycle due to staff changes and confusion of full assessment timing.

Changes to the input data include: 1) management region specific catch information and commercial fishery average weights updated through October 24, 2022; 2) relative abundance estimates from the ROV survey for the Central Southeast Outside (CSEO) management unit; and 3) catch-per-unit-effort (CPUE) of yelloweye rockfish in the IPHC longline survey was incorporated for the first time and used as a secondary index of abundance in the Random Effects Multi-area (REMA) models. The preferred REMA selected for setting the OFL and ABC used the ADF&G biomass estimates and CPUE estimates of yelloweye rockfish in the IPHC longline survey in the four management areas that comprise the SEO with an extra observation error term estimated for the biomass estimates.

##### *Spawning biomass and stock trends*

The estimated yelloweye rockfish biomass increased from 2022 to 2023. Please note that change in biomass from 2022 to 2023 is the result of a change in methodology adopted in this year's assessment. Prior assessments used and reported the lower 90% confidence interval of the biomass estimate where-as this assessment applies and reports the point estimate of biomass.

##### *Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Under Tier 5 for yelloweye rockfish, the overfishing level (OFL) was set using  $F_{35\%}=0.02$ . The author's recommended  $F_{ABC}$  ( $F=M=0.01275$ ) included a 15% reduction from  $\max F_{ABC}$  and resulted in a 2023 ABC of 244 t. The Team discussed the author's rationale for reduction from  $\max F_{ABC}$  and concluded that the lower F rate associated with the change from Tier 4 to Tier 5 was a sufficient conservation buffer to address the author's concerns. The Team recommends that  $F_{ABC}$  be set at  $\max F_{ABC}$  ( $F=M=0.015$ ); this results in an ABC for 2023 (and 2024) of 283 t, a decrease of 22% from the 2022 ABC.



### *Status determination*

The DSR stock complex in the SEO district of the Gulf of Alaska is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable.

### *Area apportionment*

The ABC and OFL for DSR are for the SEO District. DSR management is deferred to the State of Alaska and any further apportionment within the SEO District is at the discretion of the State.

## **15. Thornyheads**

Status and catch specifications (t) of thornyhead rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current as of November 5th, 2022.

Year	Biomass	OFL	ABC	TAC	Catch
2021	86,802	2,604	1,953	1,953	273
2022	86,802	2,604	1,953	1,953	355
2023	72,349	2,170	1,628		
2024		2,170	1,628		

### *Changes from previous assessment*

The thornyhead complex remains on a biennial assessment schedule with full assessments in even years and no stock assessments in odd years. The last full assessment for the thornyhead complex occurred in 2020. New information in this full assessment includes: 1) catch estimates through October 6th 2022; 2) length compositions from the 2020 and 2021 longline and trawl fisheries; 3) length compositions from the 2021 GOA bottom trawl survey; 4) length compositions from the 2021 and 2022 AFSC annual longline surveys; 5) Relative Population Weights (RPW) from 1992 to 2022 GOA longline survey were updated for use in the Random Effects Multi-area model with an Additional survey (REMA) model; there were slight changes to the RPWs in the eastern GOA which resulted from updating all area sizes for extrapolating RPWs using Echave et al. (2013); and 6) biomass estimated from the 1984 and 1987 GOA trawl surveys were removed from input to the REMA model, and values from 1990 to 2021 were updated.

The methodology used to estimate exploitable biomass to calculate ABC and OFL (Over Fishing Limit) values for the 2023 fishery has changed. This year, a coding error in the REMA model was corrected, and a new model with an additional observation error term estimated for both the AFSC longline survey and bottom trawl survey is recommended (Sullivan et al. 2022a).

### *Spawning biomass and stock trends*

Estimates of spawning biomass are unavailable for thornyheads. The most recent 2021 trawl survey estimate was 13% lower than the 2019 estimate and the longline survey RPW decreased by ~20% between 2019 to 2021, and then increased by 23% in 2022, but still below time series mean. The thornyhead complex is a Tier 5 stock, and biomass is estimated by applying the random effects method to the trawl and longline survey biomass time series by region and depth in order to compensate for missing data (i.e., thornyheads are found down to 1000m, but deep survey strata are not sampled in in each trawl survey).

For the 2023 fishery, we recommend the maximum allowable ABC of 1,628 t for thornyhead rockfish. This ABC is a decrease of 17% from the 2022 ABC of 1,953 t. Approximately two-thirds of this decrease

can be attributed to changes in the model structure with the remainder due to updates in abundance indices provided by the trawl and longline surveys. The OFL is 2,170 t.

*Tier determination/Plan Team discussion and resulting ABCs and OFLs*

Thornyhead rockfish are in Tier 5. The Team concurred with the authors’ recommendations for ABC and OFL for 2023 and 2024. Gulf-wide catch of thornyheads in 2022 was 18% of the ABC.

*Status determination*

The thornyhead complex is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable.

*Area apportionment*

For apportionment of ABC/OFL, the REMA model was fit to area-specific biomass and RPWs, and subsequent proportions of biomass by area were calculated. The following table shows the recommended apportionment and ABC value by regulatory area for 2023.

Year	Western	Central	Eastern	Total
2023	314	693	621	1,628
2024	314	693	621	1,628

**16. Other rockfish (no assessment)**

In accordance with the approved schedule, no assessment was conducted for other rockfish this year. However, a full stock assessment will be conducted in 2023. Until then, the values generated from the previous stock assessment (<https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAorock.pdf>) will be rolled over for 2023 specifications. Please refer to the last full stock assessment for details regarding the rolled over estimates.

Status and catch specifications (t) of other rockfish. Biomass estimates for 2023 and 2024 are based on the random effects model for Tier 4 and 5 species from the 2021 assessment. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. \*Note that 1 t of northern rockfish has been added for management purposes to the Other rockfish complex in WYAK of the EGOA. Catch data are current through November 5th, 2022.

Tier 5

Year	Biomass	OFL	ABC	TAC	Catch
2021	70,687	5,320	4,053	1,609	1,216
2022	67,325	5,320	4,054	1,610	1,266
2023	67,325	5,320	4,054		
2024		5,320	4,054		

*Area apportionment*

Area apportionment is based on the sum of random effects model biomass (Tier 4 and 5 species) and catch history (Tier 6 species) by region. In 2021, the Team again recommended a single ABC for the combined WGOA and CGOA areas to address concerns about the ability to manage smaller ABCs in the WGOA. As the Team recommended rolling over ABCs/OFLs from 2021 for 2022 due to uncertainties in survey biomass, the apportionment percentages are also rolled over to reflect the 2021 percentages. The following table shows the rolled over recommended area apportionment (t) for 2023 and 2024.

Year	Other Rockfish	W/C GOA	WYAK	EYAK/SE	Total
2023	ABC (t)	940	*370	2,744	4,054
2024	ABC (t)	940	*370	2,744	4,054

\*Note that the small northern rockfish ABC apportionments from EGOA are combined with OR in the WYAK management area and added for management purposes here from the Plan Team recommended apportionments for OR.

### 17. [Atka mackerel](#) (no assessment)

In accordance with the approved schedule, no assessment was conducted for Atka mackerel this year. However, a full stock assessment will be conducted in 2023. Until then, the values generated from the previous stock assessment (<https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAatka.pdf>) will be rolled over for 2023 specifications. Please refer to the last full stock assessment for details regarding the rolled-over estimates.

Status and catch specifications (t) of Atka mackerel in recent years. Atka mackerel are managed under Tier 6 because reliable estimates of biomass are not available. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th, 2022.

Tier 6

Year	Biomass	OFL	ABC	TAC	Catch
2021		6,200	4,700	3,000	939
2022		6,200	4,700	3,000	880
2023		6,200	4,700		
2024		6,200	4,700		

#### *Area apportionment*

Atka mackerel are managed Gulf-wide.

### 18. [Skates](#) (no assessment)

In accordance with the approved schedule, no assessment was conducted for the skate complex this year. However, a full stock assessment will be conducted in 2023. Until then, the values generated from the previous stock assessment (<https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAskate.pdf>) will be rolled over for 2023 specifications. Please refer to the last full stock assessment for details regarding the rolled over estimates.

Status and catch specifications (t) of skates. Biomass for each year corresponds to the projection given in the SAFE report of the last full assessment. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th, 2022.

Tier 5

Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2021		4,278	3,208	3,208	765
	2022		3,822	2,867	2,867	944
	2023		3,822	2,867		
	2024		3,822	2,867		
Longnose Skate	2021		3,449	2,587	2,587	1,035
	2022		3,616	2,712	2,712	940
	2023		3,616	2,712		
	2024		3,616	2,712		
Other Skates	2021		1,166	875	875	732
	2022		1,311	984	984	822
	2023		1,311	984		
	2024		1,311	984		

*Area apportionment*

In 2021, the author continued the use of the random effects (RE) model, a separate RE model was run for each managed group, and for each regulatory area. Big and longnose skates have area-specific ABCs and Gulf-wide OFLs; other skates have a Gulf-wide ABC and OFL.

Year	Species	Western	Central	Eastern	Total
2023	big skate	591	1,482	794	2,867
2024		591	1,482	794	2,867
2023	longnose skate	151	2,044	517	2,712
2024		151	2,044	517	2,712
2023	other				984
2024	skates				984

## 19. [Sharks](#)

Status and catch specifications (t) of the GOA shark complex and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th, 2022.

Year	Biomass*	OFL	ABC	TAC	Catch
2021	23,289	5,006	3,755	3,755	1,933
2022	23,289	5,006	3,755	3,755	2,112
2023	31,243	6,521	4,891		
2024		6,521	4,891		

\*Spiny dogfish random effects modelled biomass only.

### *Changes from the previous assessment*

The GOA shark complex (Spiny Dogfish, Pacific Sleeper Shark, Salmon Shark, and Other/Unidentified Sharks) is assessed on a biennial stock assessment schedule. A full assessment was conducted for the shark complex this year. New information for this assessment included GOA shark catch from 2003-2022 (through October 8, 2022), as well as the following updated survey indices:

- NMFS bottom trawl through 2021 (informs Spiny Dogfish)
- International Pacific Halibut Commission (IPHC) longline through 2021 (informs Pacific Sleeper Shark)

The assessment of sharks in 2022 was presented as a combined document for both the GOA and BSAI FMP areas to ease scientific review, although the Analytic Approach and Results sections were largely segregated by FMP. There were no changes to assessment methodology for Spiny Dogfish (Model 15.3A), which used the random effects model-estimated biomass adjusted by a catchability parameter to estimate an adjusted biomass. No alternatives for Salmon Shark were evaluated and the status quo (SS11.0) was recommended. In addition to the status quo approaches (Model 11.0), alternative analyses were presented for GOA Pacific Sleeper Sharks and Other/Unidentified sharks:

- PSS22.0 – Refined ORCS approach; multiplies catch statistic based on stock status by scalar correlated to risk tolerance
- GOA22.0 – OFL is based on the 90<sup>th</sup> percentile of the mean catch time series to avoid undue influence from large/misreported hauls; years of catch time series is maintained from previous assessments (i.e., 1997-2007)

The Team recommended use of status quo methods for all shark complex components.

### *Spawning biomass and stock trends*

There was a 25% increase in estimated spiny dogfish exploitable biomass from the 2020 assessment value; this increase was due to a substantial increase in estimated biomass in the Eastern GOA (9,917 t to 18,494 t). Although the ORCS methodology is not recommended at this time for setting harvest specifications, the analysis of available information for Pacific sleeper shark did raise substantial concerns for this stock related to recruitment overfishing and likely low productivity of the species.

### *Tier determination/Plan Team discussion and resulting ABC and OFL recommendations*

For ABC/OFL estimates, spiny dogfish are managed as Tier 5, while the other components remain in Tier 6. The total OFL for the GOA shark complex is the sum of the Tier 5 and Tier 6 recommendations for each species. The recommended ABC for 2023/2024 represents a 23% increase from the 2022 ABC (see

table above for details). This increase is entirely from the large contribution of spiny dogfish. The Team’s recommended ABC and OFL using the status quo methods are reflected in the table above.

*Status determination*

Sharks are not targeted in any federal or state managed waters of the GOA. However, sharks are caught incidentally in other target fisheries. A vast majority of this incidental catch is discarded with discard mortality estimated at 100%. There were insufficient data to determine if the shark complex is in an overfished condition, but the complex is not currently being subjected to overfishing. There is no evidence to suggest that overfishing is occurring for any shark species in the GOA because the OFL has not been exceeded.

*Area apportionment*

GOA sharks are managed Gulf-wide.

**20. Octopus (no assessment)**

In accordance with the approved schedule, no assessment was conducted for octopus this year. However, a full stock assessment will be conducted in 2023. Until then, the values generated from the previous stock assessment (<https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOAocto.pdf>) will be rolled over for 2023 specifications. Please refer to the last full stock assessment for details regarding the rolled over estimates.

Status and catch specifications (t) of GOA octopus. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th, 2022.

Tier 6

Year	Biomass	OFL	ABC	TAC	Catch
2021	-	1,307	980	980	55
2022	-	1,307	980	980	111
2023	-	1,307	980		
2024	-	1,307	980		

*Area apportionment*

GOA octopus are managed Gulf-wide.

**Appendix 1. Forage species**

A report on the status of forage species in the Gulf of Alaska is prepared on a biennial basis in even years. While not a formal stock assessment, forage populations are analyzed if data are available. The forage fish category in the GOA Groundfish FMP includes the following species or groups of species: 1) more than 50 species in the “forage fish group” that are listed in an appendix of the assessment; 2) Pacific herring *Clupea pallasii*; 3) juvenile groundfishes and salmon; 4) shrimps; and 5) squids. Species in the forage fish category have been identified as having ecological importance as prey, and directed fishing is prohibited for the group. As of 2011, the forage fish category in the GOA Groundfish FMP is managed within the “ecosystem component” of the FMP. The report primarily displays data from the GOA bottom trawl surveys, and includes trends in biomass, abundance, prevalence, and distribution, as well as a section on bycatch and other conservation issues.

## Tables

Table 1. Gulf of Alaska groundfish 2023-2024 OFLs and ABCs, 2022 TACs, and 2022 catch (reported through 11/5/22). Note totals depend on sablefish apportionment methods.

Species	Area	2022				Plan Team Rec 2023		Plan Team Rec 2024		
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC	
Pollock	State GHL	n/a	3,327	n/a		n/a	3,723	n/a	4,027	
	W (610)	n/a	23,714	23,714	23,595	n/a	26,958	n/a	29,156	
	C (620)	n/a	69,250	69,250	69,341	n/a	77,005	n/a	83,283	
	C (630)	n/a	30,068	30,068	30,499	n/a	33,729	n/a	36,478	
	WYAK	n/a	6,722	6,722	6,441	n/a	7,523	n/a	8,136	
	Subtotal		154,983	133,081	129,754	129,876	173,470	148,938	186,101	161,080
	EYAK/SEO		15,150	11,363	11,363	0	15,150	11,363	15,150	11,363
Total		170,133	144,444	141,117	129,876	188,620	160,301	201,251	172,443	
Pacific Cod	W	n/a	9,942	6,959	4,926	n/a	7,464	n/a	6,873	
	C	n/a	19,752	14,814	13,070	n/a	14,830	n/a	13,655	
	E	n/a	3,117	2,338	279	n/a	2,340	n/a	2,155	
	Total		39,555	32,811	24,111	18,275	29,737	24,634	27,507	22,683
Sablefish	W	n/a	3,727	3,727	2,799	n/a	4,473	n/a	4,626	
	C	n/a	9,965	9,965	7,342	n/a	9,921	n/a	8,819	
	WYAK	n/a	3,437	3,437	2,643	n/a	3,205	n/a	2,669	
	SEO	n/a	5,665	5,665	4,747	n/a	5,602	n/a	4,981	
	GOA Total <sup>1</sup>	n/a	22,794	22,794	17,531	n/a	n/a	n/a	n/a	
	AK Total		40,432	34,521	n/a	n/a	47,390	40,502	48,561	41,539
Alaska-wide OFL and ABC <sup>2</sup>	W	n/a	21,256	13,250	33	n/a	22,485	n/a	23,299	
	C	n/a	25,305	25,305	1,251	n/a	26,769	n/a	27,737	
	WYAK	n/a	2,531	2,531	8	n/a	2,677	n/a	2,774	
	EYAK/SEO	n/a	1,518	1,518	2	n/a	1,606	n/a	1,664	
	Total		62,273	50,610	42,604	1,294	65,736	53,537	68,015	55,474
Shallow-Water Flatfish	W	n/a	256	256	2	n/a	256	n/a	255	
	C	n/a	2,139	2,139	117	n/a	2,105	n/a	2,068	
	WYAK	n/a	1,431	1,431	3	n/a	1,407	n/a	1,383	
	EYAK/SEO	n/a	2,082	2,082	0	n/a	2,048	n/a	2,013	
Total		7,026	5,908	5,908	122	6,918	5,816	6,802	5,719	
Deepwater Flatfish	W	n/a	2,981	2,981	40	n/a	3,236	n/a	3,314	
	C	n/a	12,076	12,076	654	n/a	13,110	n/a	13,425	
	WYAK	n/a	1,361	1,361	0	n/a	1,439	n/a	1,453	
	EYAK/SEO	n/a	2,723	2,723	0	n/a	2,879	n/a	2,905	
Total		23,302	19,141	19,141	694	25,135	20,664	25,652	21,097	
Rex Sole	W	n/a	33,658	14,500	438	n/a	30,469	n/a	30,093	
	C	n/a	68,394	68,394	10,926	n/a	65,000	n/a	64,200	
	WYAK	n/a	6,707	6,707	36	n/a	7,886	n/a	7,789	
	EYAK/SEO	n/a	11,020	6,900	56	n/a	16,130	n/a	15,932	
Total		143,100	119,779	96,501	11,456	142,749	119,485	141,008	118,014	
Flathead Sole	W	n/a	14,755	8,650	42	n/a	12,793	n/a	13,033	
	C	n/a	22,033	15,400	521	n/a	21,487	n/a	21,892	
	WYAK	n/a	1,511	1,511	0	n/a	2,320	n/a	2,363	
	EYAK/SEO	n/a	1,876	1,876	0	n/a	2,880	n/a	2,934	
Total		48,928	40,175	27,437	563	48,161	39,480	49,073	40,222	
Pacific ocean perch	W	n/a	2,602	2,602	2,506	n/a	2,529	n/a	2,461	
	C	n/a	30,806	30,806	25,039	n/a	29,940	n/a	29,138	
	WYAK	n/a	1,409	1,409	1,398	n/a	1,370	n/a	1,333	
	W/C/WYAK	41,470	34,817	34,817	28,943	40,308	33,839	39,229	32,932	
	SEO	4,110	3,451	3,451	0	3,994	3,354	3,888	3,264	
Total		45,580	38,268	38,268	28,943	44,302	37,193	43,117	36,196	
Northern Rockfish	W	n/a	1,944	1,944	474	n/a	2,614	n/a	2,497	
	C	n/a	3,202	3,202	1,405	n/a	2,350	n/a	2,244	
	E	n/a	0	0	0	n/a	-	n/a	-	
	Total		6,143	5,146	5,146	1,879	5,927	4,964	5,661	4,741

Species	Area	2022				Plan Team Rec 2023		Plan Team Rec 2024	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Shortraker Rockfish	W	n/a	51	51	7	n/a	51	n/a	51
	C	n/a	280	280	287	n/a	280	n/a	280
	E	n/a	374	374	149	n/a	374	n/a	374
	Total	940	705	705	443	940	705	940	705
Dusky Rockfish	W	n/a	269	269	106	n/a	149	n/a	141
	C	n/a	4,534	4,534	2,455	n/a	7,647	n/a	7,264
	WYAK	n/a	427	427	6	n/a	90	n/a	85
	EYAK/SEO	n/a	142	142	1	n/a	31	n/a	30
	Total	8,614	5,372	5,372	2,568	9,638	7,917	9,154	7,520
Rougheye and Blackspotted Rockfish	W	n/a	184	184	95	n/a	180	n/a	180
	C	n/a	235	235	183	n/a	232	n/a	231
	E	n/a	369	369	160	n/a	363	n/a	361
	Total	947	788	788	438	930	775	927	772
Demersal shelf rockfish	Total	579	365	365	163	376	283	376	283
Thornyhead Rockfish	W	n/a	352	352	108	n/a	314	n/a	314
	C	n/a	910	910	173	n/a	693	n/a	693
	E	n/a	691	691	74	n/a	621	n/a	621
	Total	2,604	1,953	1,953	355	2,170	1,628	2,170	1,628
Other Rockfish	W/C	n/a	940	940	1,134	n/a	940	n/a	940
	WYAK	n/a	370	370	76	n/a	370	n/a	370
	EYAK/SEO	n/a	2,744	300	56	n/a	2,744	n/a	2,744
	Total	5,320	4,054	1,610	1,266	5,320	4,054	5,320	4,054
Atka mackerel	Total	6,200	4,700	3,000	880	6,200	4,700	6,200	4,700
Big Skate	W	n/a	591	591	163	n/a	591	n/a	591
	C	n/a	1,482	1,482	668	n/a	1,482	n/a	1,482
	E	n/a	794	794	113	n/a	794	n/a	794
	Total	3,822	2,867	2,867	944	3,822	2,867	3,822	2,867
Longnose Skate	W	n/a	151	151	58	n/a	151	n/a	151
	C	n/a	2,044	2,044	482	n/a	2,044	n/a	2,044
	E	n/a	517	517	400	n/a	517	n/a	517
	Total	3,616	2,712	2,712	940	3,616	2,712	3,616	2,712
Other Skates	GOA-wide	1,311	984	984	822	1,311	984	1,311	984
Sharks	GOA-wide	5,006	3,755	3,755	2,112	6,521	4,891	6,521	4,891
Octopuses	GOA-wide	1,307	980	980	111	1,307	980	1,307	980
<b>TOTAL</b>		626,738	508,311	448,118	221,675	646,826	539,072	658,311	550,224



Table 2. 2023 and 2024 Halibut Discard Mortality Rates for Vessels Fishing in the Gulf of Alaska.  
 (Values are in percent of halibut assumed to be dead.)

Gear	Sector	Groundfish fishery	Halibut discard mortality rate
Pelagic trawl	Catcher vessel	All	100%
	Catcher/processor	All	100%
Non-pelagic trawl	Catcher vessel	Rockfish Program	55%
	Catcher vessel	All others	74%
	Mothership and catcher/processor	All	83%
Hook-and-line	Catcher/processor	All	13%
	Catcher vessel	All	9%
Pot	Catcher vessel and catcher/processor	All	27%